OPERATING AND SERVICE MANUAL

GARDNER DENVER

MULTISTAGE CENTRIFUGAL BLOWERS/ EXHAUSTERS

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IMPORTANT INSTALLATION INFORMATION

To ensure that you get the best expected service life from this equipment, there are specific blower and motor installation and alignment procedures that must be observed. These instructions are outlined in this comprehensive Operating & Service Manual.

Blowers are low pressure compressors, and they operate at elevated discharge temperatures due to the heat of compression occurring through multiple stages. This results in the outlet end of the blower having more thermal growth than the inlet end. This uneven growth requires careful offset of the blower to the motor to ensure that when the blower and motor reach operating temperatures, normally
1 ½ - 2 hours after start-up, the correct hot alignment can be achieved.

Our scope of supply, including the blower, motor and applicable accessories, are covered by Gardner Denver's and our sub-vendor's standard warranties against defects in material and workmanship. These warranties do not cover failures caused by improper installation, alignment or operation and maintenance, or by normal wear and tear. As such, proper installation, alignment and operation and maintenance of this equipment are necessary to insure the warranty is not voided.

If you feel you do not have the training or instrumentation to perform these start-up services, it is suggested you consider having Gardner Denver supervise the installation and start-up. Typical start-up services include laser alignment, lubrication of Gardner Denver supplied equipment and operator training. In addition, complete laser alignment, vibration and bearing temperature baseline results will be provided to document that the start-up was properly completed.

MAINTAIN BLOWER RELIABILITY AND PERFORMANCE WITH GENUINE GARDNER DENVER, INC PARTS AND SUPPORT SERVICES

Genuine Gardner Denver factory parts, engineered to original tolerances, are designed for optimum dependability and performance, specifically for your blower. Design and material innovations result from years of experience with hundreds of different blower applications. When you specify genuine factory parts, you are assured of receiving parts that incorporate the most current design advancements, manufactured in our state-of-the-art centrifugal blower factory under exacting ISO 9001:2000 quality standards. Gardner Denver Authorized/Certified Repair Centers offer all the back-up you require. Factory-trained service technicians provide the finest product support in the blower industry on a worldwide basis.

Contact Information:

Gardner Denver Engineered Products Division
100 Gardner Park
Peachtree City, GA 30269
Phone: (770) 632-5000
Toll Free: 800-982-3009
FAX: (770) 486-5530 (parts)
FAX: (770) 631-0765 (service)

INSTRUCTIONS FOR ORDERING REPAIR PARTS

For pricing and delivery information, contact your local Sales Representative or our Customer Service team at our Peachtree City factory.

When ordering parts, specify the Blower Model, Serial Number (see data plate on unit) and sales order number, if available.

Rely upon the knowledge and experience of your local sales representative or our customer service team and let them assist you in making the proper parts selection for your blower.

NOTE: This manual is applicable for the following models:
Current catalog models: 260, 310, 400, 510, 725, 550, 42, 732, 850, 741, 870, 742, 751, 1260, 752, 1270, 761, 1400, 1600, 1870, 2000, and 2400.

Non-catalog models: 250, 383, 40, 41, 600, 642, 650, 652, 671, 691, 772, 781, 791, 810, 860, 1210 and 1250.

Please consult factory with any questions.

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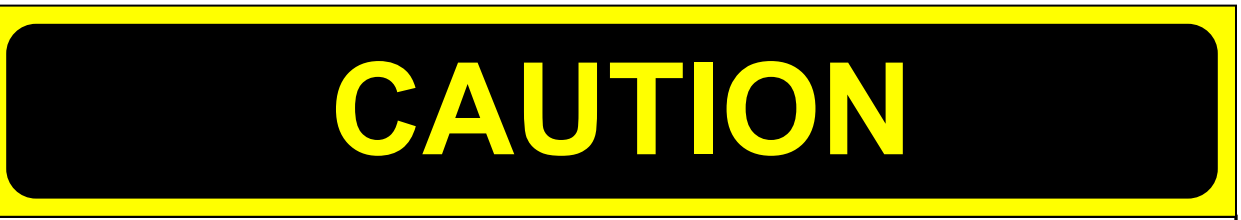
FOREWORD

Gardner Denver blowers/exhausters, marketed under the Hoffman, Lamson and Gardner Denver brand names, are the result of advanced engineering and skilled manufacturing. To be assured of receiving maximum service from this machine, the owner must exercise care in its operation and maintenance. This book is written to give the operator and maintenance department essential information for day-to-day operation, maintenance and adjustment. Careful adherence to these instructions will result in safe, economical operation and minimum downtime.

Danger is used to indicate the presence of a hazard that will cause severe personal injury, death or substantial property damage if the warning is ignored.

Warning is used to indicate the presence of a hazard that will cause severe personal injury, death or substantial property damage if the warning is ignored.



Caution is used to indicate the presence of a hazard that will or can cause severe personal injury or property damage if the warning is ignored.

Notice is used to notify people of installation, operation or maintenance information that is important but not hazard-related.

SAFETY PRECAUTIONS

Safety is everybody's business and is based on your use of good common sense. All situations or circumstances cannot always be predicted and covered by established rules. Therefore, use your past experience, watch out for safety hazards and be cautious. Some general safety precautions are given below:

DANGER

Failure to observe these notices could result in injury to or death of personnel.

Keep fingers and clothing away from inlet and discharge ports, rotating belts, openings in bearing housings, sheaves, drive coupling, etc.

Do not use the air discharge from this unit for breathing - not suitable for human consumption.

Do not loosen or remove the oil filler plug, drain plugs, covers or break any connections, etc., in the air or oil system until the unit is shut down and the air pressure has been relieved.

Electrical shock can and may be fatal.

Unit must be grounded in accordance with the National Electrical Code.

Open main disconnect switch, tag and lockout before working on the control.

Disconnect the unit from its power source, tag and lockout before working on the unit - the machine may be automatically controlled and may start at any time.

WARNING

Failure to observe these notices could result in damage to equipment.

Stop the unit if any repairs or adjustments on or around the blower are required.

Disconnect the unit from its power source, tag and lockout before working on the unit - the machine may be automatically controlled and may start at any time.

Do not exceed the rated maximum speed shown on the nameplate.

Do not operate unit if safety devices are not operating properly. Check periodically. Never bypass safety devices.

GARDNER DENVER'S QUALITY POLICY:
Gardner Denver is committed to provide on-time delivery of competitively priced products and services that meet or exceed our customers' requirements. We will achieve this by maintaining a quality system devoted to the prevention of quality deficiencies and to continuous improvement.

INTRODUCTION

Thank you for investing in Gardner Denver quality. The Gardner Denver reputation for rugged dependability has been earned by over 100 years of service in demanding, industrial operations where downtime cannot be tolerated and efficient blower performance is expected. Your Gardner Denver blower is a precision blower that has been carefully manufactured and thoroughly tested at the state-of-the-art Gardner Denver, Inc. blower factory in Peachtree City, Georgia.

As with other precision machinery, there are several relatively simple installation, operation and maintenance procedures that you must observe to assure optimum blower performance. There is no guesswork in the manufacture of your highly advanced Gardner Denver blower and there must be none in preparing the blower to get the job done in the field.

The purpose of this manual is to help you properly install, operate and maintain your blower. It is essential that you review all sections of this manual in preparation for installing your blower. Follow the instructions carefully and you will be rewarded with trouble-free Gardner Denver service, year in and year out.

OPERATING PRINCIPLES

The Gardner Denver centrifugal blower is a dynamic type compressor. It uses an impeller within a casing called a diffuser. As the impeller rotates, air enters the eye of the impeller. The rotational speed of the impeller imparts a high velocity to the air as it moves radially outward into the diffuser, which converts part of the velocity head into a static pressure head. By employing a number of impellers in series, multi-staging will produce high pressure. Air that has left the diffuser of a previous section or stage moves radially inward to the eye of the next impeller, and the process is repeated, increasing pressure with each stage.

WHERE TO CALL FOR GARDNER DENVER BLOWER ASSISTANCE:
For prompt, professional Gardner Denver service always contact your Customer Service Representative first. If you do not know your Customer Service Representative, please refer to the following contact information:

Gardner Denver Engineered Products Division
100 Gardner Park
Peachtree City, GA 30269
Phone: (770) 632-5000
Toll Free: 800-982-3009
FAX: (770) 486-5530 (parts)
FAX: (770) 631-0765 (service)

SECTION I
EQUIPMENT CHECK

Immediately upon receipt, thoroughly examine the equipment. Both motor and blower shafts should rotate freely. There should be no evidence of damage, cracked castings, bent tie rods or any other unusual conditions. Most equipment is shipped Ex Works factory, meaning that the purchaser is responsible for the machine when it leaves the factory. If damage has occurred, or any material is missing, note on the delivering carrier's freight bill and make sure the driver signs same on the receiving copy. Notify the delivering carrier at once and also notify your Gardner Denver representative. Do not return the blower to the factory until you have recorded the discrepancy with the driver and have notified your representative and the factory and have received return authorization approval.

NOTE: FREIGHT DAMAGE IS THE RESPONSIBILITY OF THE DELIVERING CARRIER. IF SHIPMENTS ARRIVE DAMAGED, CUSTOMER OR RECEIVING PARTY MUST CONTACT CARRIER AND SUBMIT A CLAIM.

WARNING

Customers are cautioned to provide adequate protection, warning and safety equipment necessary to protect personnel against hazards involved in installation and operation of this equipment in the system or facility.

STORAGE

Short-Term Storage

Your Gardner Denver centrifugal blower should be stored in a clean, dry, well-ventilated area. Keep equipment covered and out of the elements (canvas preferred over plastic). The storage area should be heated to prevent condensation, and it must be free of ambient or transient vibration. **Rotate the blower and motor shaft at least once a week to prevent bearings from developing flat spots and to keep lubrication evenly distributed in bearings during idle periods. Be sure to keep a log of shaft rotations to ensure machine warranty protection.**

Long-Term Storage

For storage periods longer than 90 days, the same instructions apply. In addition, the following steps must also be considered:

A. Blower Maintenance
   Every six months, one protective flange cover should be removed to inspect internal surfaces of the machine. Renew vapor phase inhibitors if evidence of rust is visible. Inspect exterior surfaces and coat with a rust-inhibitor primer where necessary (e.g. exposed shaft surfaces).

B. Motor Maintenance
   Use only lubricant specified in motor O&M Manual. Note that this lubricant may be different than that used in the blower. Please review motor O&M Manual for complete lubrication and maintenance procedures.

WARNING

Rotating components will cause severe injury in case of personal contact. Keep hands away from blower inlet and discharge ports.

SECTION II
INSTALLATION & HANDLING

A. Location

1. The location selected should be clean, dry, properly drained and adequately ventilated.
2. Heated, indoor locations are preferable.
3. Plan ahead. Ample room is required for maintenance, lubrication and the removal of the machine or driver for servicing.

B. Handling

The unloading and handling of Gardner Denver equipment is the users responsibility and should be performed by personnel experienced in handling heavy machinery.

The complete assembly can be lifted from beneath the steel base (Figure 1) or with lifting eyes if provided (Figure 2). For bare machines, use slings located as close as possible to inlet head and outlet head (Figure 3). Never lift with a sling around the shaft or flange, as damage may occur to the machine. The slings should be located under the tie rods to prevent damage.

Eyebolts are NOT supplied with the machine. If eyebolts will be used to lift the blower, Gardner Denver recommends the use of drop forged, weldless shoulder pattern eyebolts, using full-size flat washers and nuts, screwed all the way down and properly seated.

NOTICE

Eye bolts can fail due to mishandling, improper use, alteration, excessive heat, paint or wear. Always stand clear of load when handling and lifting.

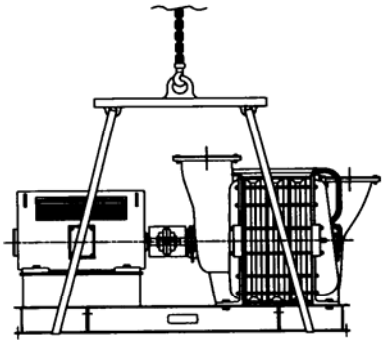


FIGURE 1

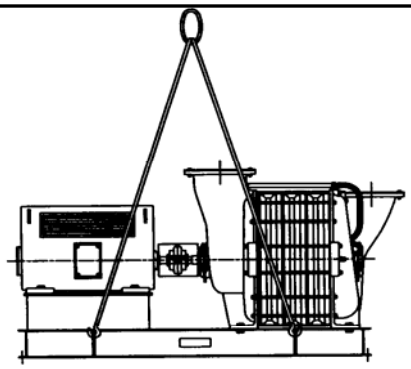


FIGURE 2

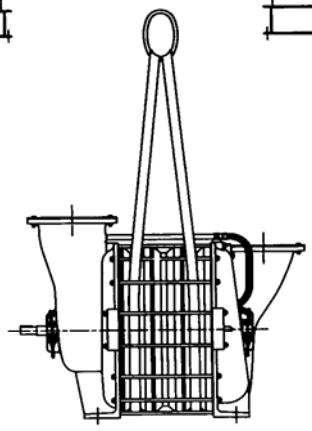


FIGURE 3

C. Foundation

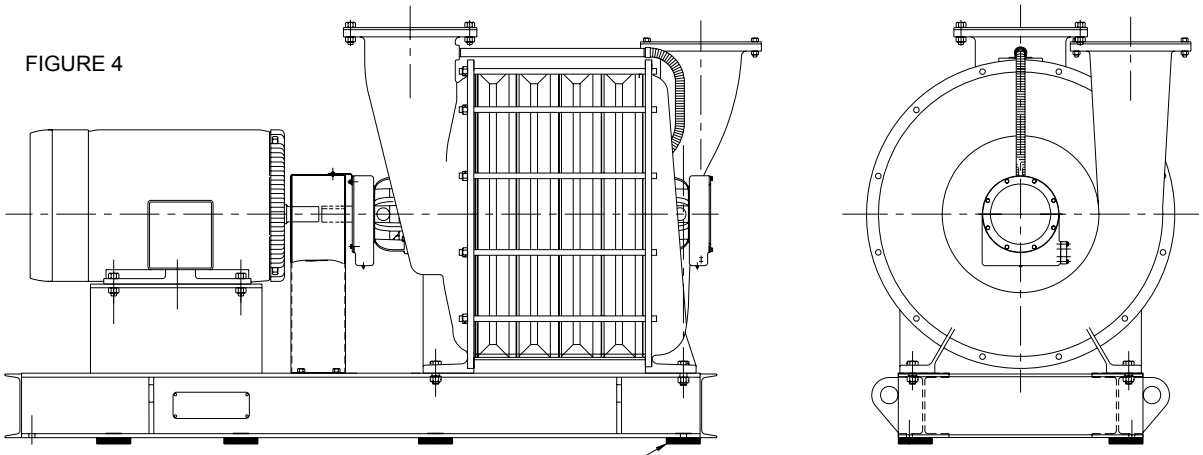
The structural design of this unit and the smooth operation inherent in the centrifugal machinery eliminates the need for massive foundations and costly site preparation. The blower should rest on a solid, level, flat, smooth surface such that it will support the dead weight of the unit. Avoid mezzanines, catwalks and hollow floors. Foundations must be clean and level within 1/16” per foot slope or a maximum of 1/8” over the length and width of the base.

D. Positioning

Each blower is shipped with a quantity of resilient mounting pads. Location of pads is shown on blower base skid. As a reference see Figure 4. Use shims (equal to or larger in size than the base pads) **under** the mounting pads as required to level the unit. Do not use shims between the base and pads. Level in the lateral plane is especially important for oil lubricated machines.

Locating studs may be used to position the machine, but should not be used to anchor the unit. Anchoring the unit (or worse, grouting the base in concrete) greatly increases the support stiffness and may result in increased levels of vibration measured at the bearings. It is unnecessary, costly and may degrade mechanical performance. The locating studs should not make contact with the base. There must be clearance all around the studs.

FIGURE 4



THE POSITION AND NUMBER OF PADS SHOWN IS REPRESENTATIVE ONLY. THEY SHOULD BE SHIMMED AND SPACED AS REQUIRED TO ACHIEVE UNIFORM LOAD DISTRIBUTION. SHIMMING SHOULD BE PLACED BETWEEN THE PAD AND FOUNDATION.

WARNING

If anchor bolts are present, do NOT bolt down! Hand tighten ONLY!

CAUTION

Gardner Denver strongly discourages grouting of the unit. Use of grouting may void warranty.

Gardner Denver recommends the use of vibration pads under multistage centrifugal base skids. Foundation studs are used to locate Gardner Denver multistage centrifugal blowers. Tightening nuts on the foundation studs is not recommended for several reasons. It is better to dampen vibration than to mask it in structural bases. Any piece of rotating machinery will introduce energy into the structure to which it is mounted. This energy is measured as vibration. Vibration energy will create internal stresses in structural members or be transferred out of the system by heat and sound. A rigid structure keeps more of the vibration energy trapped in the system. Vibration pads allow vibration energy to escape from the system. Vibration isolators under the base are a way to transfer vibration energy out of the system in the form of heat. When a nut is tightened on a foundation stud, the vibration pads are rendered ineffective.

E. Piping

The inlet and discharge connections on all blowers should be large enough to handle maximum volume with minimum friction loss. Reducing the pipe diameter on either the inlet or discharge will create additional line loss and increase the overall pressure differential, causing inefficient operation and wasted energy.

The excessive weight of piping and fittings on blower flanges will cause internal misalignment and premature wear. Never allow the blower to carry the weight of the piping. A spool or sleeve-type expansion joint should be installed between the unit and the piping. These expansion joints should not be used to compensate for pipe misalignment. Control or restraining rods are not normally recommended. If they must be used, do not bolt up hard on both flanges because thermal movement will be restricted, causing increased vibration levels. Where a flexible connection is not practical, the weight of the rigid connection must be separately supported and provision must be made for thermal growth. Flange loads must not exceed the limits shown in Table 1.

All system piping must be cleaned internally before connection to the blower. Debris left in piping will damage the blower.

NOTICE

Flexible isolation sleeves or expansion joints must be used to isolate blower from piping system.

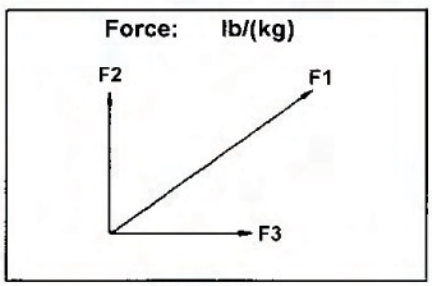


FIGURE 5

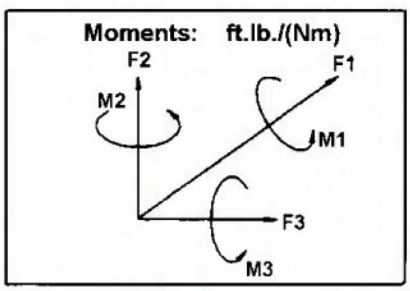


FIGURE 6

TABLE 1: Maximum Allowable Flange Forces and Moments
(On page 4, refer to Figure 5 for Force and Figure 6 for Moments)

INLET FLANGE	F1		F2		F3		M1		M2		M3	
Series	PARALLEL TO SHAFT		VERTICAL TO SHAFT		HORIZONTAL 90° TO SHAFT		PARALLEL TO SHAFT		VERTICAL TO SHAFT		HORIZONTAL 90° TO SHAFT	
	lb	N	lb	N	lb	N	ft-lb	N-m	ft lb	N-m	ft lb	N-m
310	30	133	90	400	60	267	100	136	50	68	50	68
400	40	178	120	534	80	356	200	271	100	136	100	136
510	40	178	120	534	80	356	200	271	100	136	100	136
725	60	267	150	667	120	534	300	407	150	203	150	203
550	50	222	150	667	100	445	300	407	150	203	150	203
42	60	267	150	667	120	534	300	407	150	203	150	203
732	60	267	150	667	120	534	300	407	150	203	150	203
850	60	267	180	801	120	534	400	542	200	271	200	271
741	80	356	200	890	160	712	400	542	200	271	200	271
870	80	356	240	1068	160	712	500	678	250	339	250	339
742	100	445	250	1112	200	890	500	678	250	339	250	339
751	120	534	300	1334	240	1068	600	813	300	407	300	407
1260	100	445	300	1334	200	890	700	949	350	475	350	475
752	140	623	350	1557	280	1246	700	949	350	475	350	475
1270	150	667	450	2002	300	1334	900	1220	450	610	450	610
761	140	623	350	1557	280	1246	700	949	350	475	350	475
1400	200	890	600	2669	400	1779	1200	1627	600	813	600	813
1600	180	801	450	2002	360	1601	1050	1424	525	712	525	712
1870	200	890	660	2936	440	1957	1400	1898	700	949	700	949
2000	200	890	660	2936	440	1957	1400	1898	700	949	700	949
2400	240	1068	720	3203	480	2135	1500	2034	750	1017	750	1017

OUTLET FLANGE	F1		F2		F3		M1		M2		M3	
Series	PARALLEL TO SHAFT		VERTICAL TO SHAFT		HORIZONTAL 90° TO SHAFT		PARALLEL TO SHAFT		VERTICAL TO SHAFT		HORIZONTAL 90° TO SHAFT	
	lb	N	lb	N	lb	N	ft lb	N-m	ft lb	N-m	ft lb	N-m
310	30	133	90	400	60	267	100	136	50	68	50	68
400	40	178	120	534	80	356	200	271	100	136	100	136
510	40	178	120	534	80	356	200	271	100	136	100	136
725	50	222	125	556	100	445	250	339	125	169	125	169
550	50	222	120	534	80	356	200	271	100	136	100	136
42	60	267	150	667	120	534	300	407	150	203	150	203
732	60	267	150	667	120	534	300	407	150	203	150	203
850	60	267	180	801	120	534	400	542	200	271	200	271
741	80	356	200	890	160	712	400	542	200	271	200	271
870	80	356	180	801	120	534	400	542	200	271	200	271
742	80	356	200	890	160	712	400	542	200	271	200	271
751	120	534	300	1334	240	1068	600	813	300	407	300	407
1260	100	445	300	1334	200	890	700	949	350	475	350	475
752	100	445	250	1112	200	890	500	678	250	339	250	339
1270	100	445	300	1334	200	890	700	949	350	475	350	475
761	140	623	350	1557	280	1246	700	949	350	475	350	475
1400	200	890	450	2002	300	1334	900	1220	450	610	450	610
1600	180	801	450	2002	300	1334	900	1220	450	610	450	610
1870	200	890	600	2669	400	1779	1200	1627	600	813	600	813
2000	200	890	600	2669	400	1779	1200	1627	600	813	600	813
2400	240	1068	660	2936	440	1957	1400	1898	700	949	700	949

F. Accessories

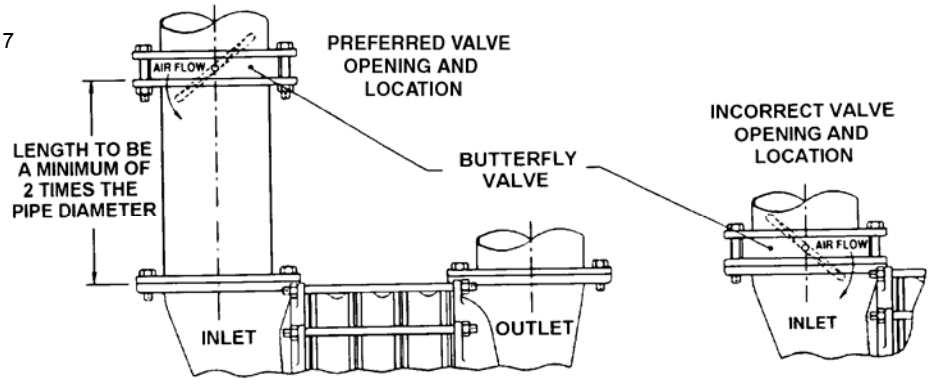
The following are the minimum recommended accessories for blower protection and reliable operation.

1. **Throttle Valve**. This is normally a butterfly valve located on the inlet of the blower that is used to control the flow through the blower. When starting the blower, the throttle valve should be in a fully closed position and slowly opened within 10-15 seconds after start-up. Occasionally, due to a long valve response time or the system process, it may be necessary to start the blower with the throttle valve at a minimum start position in lieu of starting the blower with the throttle valve fully closed. As soon as the blower reaches full speed, the throttle valve should be adjusted to allow sufficient airflow through the blower to reach the design operation point. Throttling the inlet on a pressure blower is preferred and more efficient than throttling on the discharge. The throttle valve is used to adjust the airflow through the machine to reach the design operating condition. It is also used to increase the flow to move away from surge. Surge is defined as the unstable flow of air through a machine that occurs when airflow through the dynamic compressor is reduced. As the flow is reduced, the pressure rises until the maximum pressure point is reached. As flow is further reduced, the pressure will drop below this peak point, and the downstream pressure will cause flow back into the blower. This creates a pulsation inside the machine and a very unstable condition (see Section VIII).

2. **Butterfly Valve**. In most cases, a butterfly valve is used as a throttle valve. Butterfly valves are also used as discharge blow-off valves which can control flow, although less efficiently, as the air is already compressed when it is blown off. In other words, the work is invested in the air before it is released. Butterfly valves also see service as isolation valves that allow the blower package to be worked on without being affected by the downstream pressure.

Carefully remove shipping flange covers prior to assembling accessories. Make sure no foreign materials enter the unit. When mounting the butterfly valve on the inlet, the valve should be positioned such that the valve shaft is at a right angle to the blower shaft and opens away from the body of the blower to allow smooth air entry into the blower. The rush of air should never be directed toward the first stage impeller.

FIGURE 7



NOTE: ISOLATION SLEEVE/EXPANSION JOINT OMITTED FROM FIGURE FOR CLARITY. UNIT MUST BE PROPERLY ISOLATED FROM PIPING SYSTEMS.

CAUTION

Always start blower with inlet valve closed or at a minimum start position. Open slowly after machine comes up to speed. (Not to exceed 10 seconds)

3. **Check Valve.** A check valve must be installed in the discharge piping to prevent reverse airflow from other blowers in the piping system on pressure service. On vacuum systems, the check valve must be located in the inlet line to the blower. On pressure systems, the check valve must be located downstream of any blow-off valves, and on vacuum systems it must be upstream of all bleeding devices.

Installation, maintenance and operation of check valves:
The installation of a check valve in a pipeline is as simple as installing a section of pipe. Prior to installation, the interior of the valve should be checked carefully for debris of any kind. Such debris, if not removed, may render the check valve inoperative. The internal assembly of the check valve should move freely from the open to closed position without binding. Even in the largest valves, the internals should operate easily by hand. The check valve may appear not to close tightly when so operated, but this simply means that the sealing member has not assumed its "set" and in no way should be interpreted as a failure of the valve to close easily or to seat tightly. This condition, if it exists, will be rectified by a few cycles in service. All check valve assemblies are treated with a locking solution during assembly. No loose fasteners should be found.

When valves are installed in the horizontal position, they should be bolted in place with the stationary support, the hinge post, in the vertical position, i.e., in such a manner that the bolts protruding through the valve body are at the top and bottom of the installed valve, perpendicular to the flow. In the downward or upward positions, no special attention need be given to the hinge post position. The valve flanges are parallel and therefore the mating flanges of the connecting piping must be parallel to ensure a good joint and prevent undue strains on the valve body and flanges. Standard gaskets and sealing compounds are recommended.

4. **Isolation Sleeve/Expansion Joint.** Must be installed both in the inlet piping system and discharge piping system to ensure isolation of piping systems from unit flanges. Isolation sleeves or expansion joints must be positioned upstream of the butterfly valve on the unit inlet. The piping must be aligned to + or – ¼" offset maximum. Flange bolt holes must be matched to ¼" tolerance.

5. **Inlet Filter (blowers)**. Inlet filters are required to keep foreign material from entering the machine. Abrasive, wet or bulky material will damage the machine's internal parts and could cause catastrophic failure. Servicing frequency of filter elements is not predictable. A differential pressure indicator with a continuous gauge reading, or one with a maximum indicator, should be installed across the inlet filter. It will tell how much of the service life of the filter element has been used. It will also eliminate both premature filter servicing and premature blower failure due to a plugged filter when the filter pressure drop is used to establish maintenance points. In all cases refer to the manufacturer's service instructions. Due to the many types of filters, it is not practical to give specific instructions covering all models. In general, it is recommended to clean or replace filters when the pressure drop across the filter reaches 10" wc.

WARNING

It is extremely important to keep inlet filters clean. Dirty or plugged filters will cause a low flow or surge condition, which will result in substantial damage to the machine. Units damaged from running in surge are NOT covered under warranty.

6. **Drivers.** For electric drivers, read and comply with motor manufacturer's installation and operating instructions that are attached to the motor. Make certain that motor data plate requirements agree with the nameplate with available power supply at the job site. All wiring **MUST** be done by a licensed electrician in accordance with the National Electric Code and all local regulations.

For turbine, diesel, gasoline and natural gas drivers, read and follow the manufacturer's instructions.

On direct-coupled units, the adjustment and lubrication of couplings to the specifications of the coupling manufacturer is very important. When mounted drives are supplied from the factory, preliminary alignment has been established before shipment. However, during shipping, handling and installation, it is likely that the alignment will be disturbed, and final adjustment must be made before start-up. To reduce vibration, the coupling must be aligned to within 0.002" for both offset and angular alignment. **Final alignment is the responsibility of the owner and/or installer. Laser alignment is recommended.**

7. **Flexible Couplings.** Units coupled through flexible couplings should be aligned as accurately as possible. As a suggested limit, the two halves should indicate correct alignment within 0.002" on both the circular concentric peripheral surfaces and the separation between faces. Although most flexible couplings will withstand greater misalignment than rigid couplings, misalignment can cause vibration, possibly resulting in failure of motor bearings and/or the blower bearings.

G. Alignment Procedures

The alignment procedure used is based on the motor being the moveable component and the blower the stationary component. The motor will therefore be shimmed to achieve proper alignment with the blower remaining fixed.

The alignment procedure outlined in this section is for a standard two-element, constant speed (blower/motor) configuration. Multi-element and custom configurations, such as a blower that is driven through a gearbox or a turbine-driven blower, will be accompanied by customized alignment procedures validated by design engineers and supercede this procedure.

Proper alignment means that the driver and driven shafts rotate as closely as possible on a common axis. Each blower and motor combination is "cold" aligned to design conditions at the factory. This means the "hot" design condition is already built into the alignment. After 1 ½ - 2 hours of initial operation, this alignment may require an adjustment if vibration and bearing temperature are not within specified limits (see Section III – Operation).

It is further recommended that a hot alignment be performed. Centrifugal blowers experience thermal growth as they operate. This thermal growth results in the movement of the blower drive shaft in the vertical direction at the discharge end of the blower. A hot alignment compensates for this vertical movement so that when the blower is operating, the shafts come back into alignment.

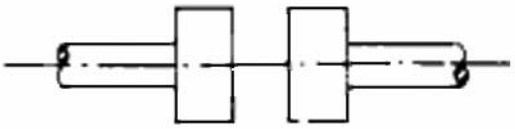
It is difficult to predict the amount of thermal growth in any particular blower because the temperature generated by the machine is subject to many variables such as ambient temperature, pressure, output, efficiency, etc.

NOTICE

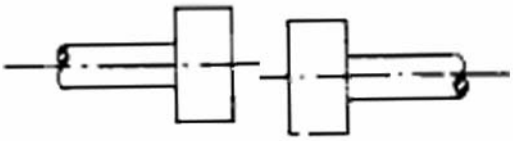
The blower may have thermal growth data on the nameplate.

Due to seasonal variations in operating conditions, blower alignment should be checked semi-annually.

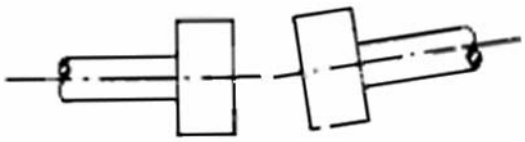
Coupling Alignment Scenarios



Perfect Alignment
Faces of coupling hubs parallel, centerlines of shafts concentric.



Parallel Misalignment
Faces of coupling hubs parallel, centerlines of shafts offset.



Angular Misalignment
Faces of coupling hubs not parallel, centerlines of shafts not concentric.

NOTE: FINAL COUPLING ALIGNMENT IS THE RESPONSIBILITY OF THE OWNER OR INSTALLER. FAILURE TO PERFORM FINAL ALIGNMENT CAN RESULT IN WARRANTY DENIAL SHOULD VIBRATION OR OTHER PROBLEMS DEVELOP. COUPLING ALIGNMENT IS NOT THE RESPONSIBILITY OF THE START-UP TECHNICIAN UNLESS PREVIOUSLY APPROVED BY THE FACTORY.

NOTICE

It is important that adequate clearance between coupling halves be maintained to allow for axial shaft growth. (See coupling manufacturer's instructions attached to the unit for specific clearance dimensions.)

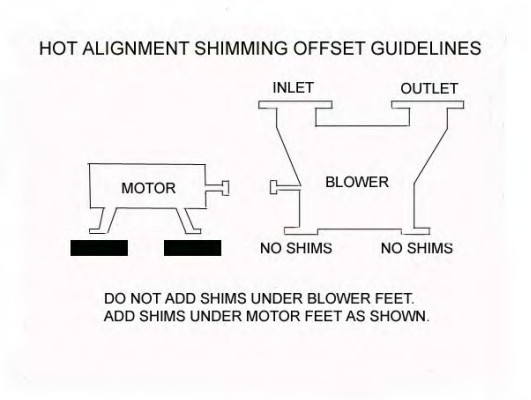
Final corrections must be made with the blower at operating temperature. Units are NOT final aligned at factory.

- Operate unit 1½ - 2 hours to get hot.
- Check vibration 0.28 IPS Max.
- Shut unit down – Make final "Hot" adjustments to Gardner Denver specification: 0.002" angularity and offset.

RPM	Angular	Offset
3600	0.005"/ 1"	0.002"
1800	0.007"/ 1"	0.004"
1200	0.010"/ 1"	0.006"
900	0.015"/ 1"	0.008"

Industry Standard Alignment Specs

Shimming Guidelines



Other Factors Related to Alignment

The following conditions can be a factor in trying to achieve good alignment:

a. Base and foundation must be level and smooth.

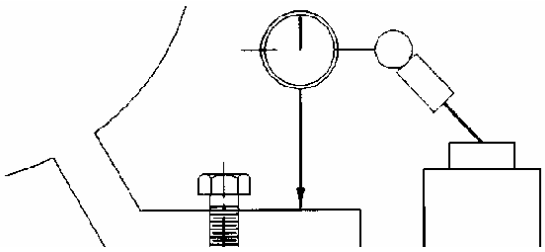
b. Piping must be isolated using flexible sleeves or expansion joints.

c. Pay particular care to outlet driven machines with horizontal discharge heads as thermal expansion can be multi-directional.

d. Machine structural base should be mounted on resilient vibration pads as supplied and should not be hard grouted. Do not bolt down hard.

e. Check for soft foot. All driver (motor) support feet must be in the same plane. When one or more feet are higher than the others, a "soft foot" condition (table-leg effect) exists that must be corrected to allow for a more exact alignment.

To check for soft foot:
With all motor hold-down bolts tight, set dial indicator at top surface of foot and zero it. Loosen that foot, noting the indicator movement. Retighten that foot. Perform the same procedure on the adjacent foot. Add shims to the foot showing the highest reading. When the reading is brought to a value of less than 0.003 inches (0.076 mm), re-check the foot that was checked first to ascertain that a new soft foot condition has not been created.



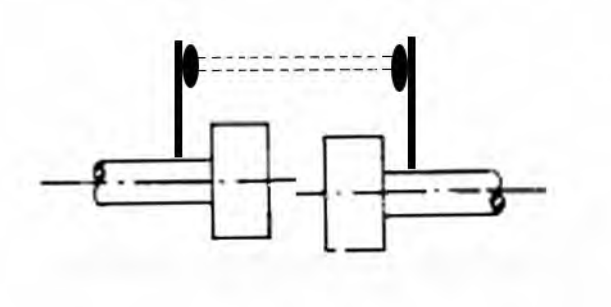
An acceptable reading before alignment is less than 0.003 inches (0.076 mm)

NOTE: THE BEST METHOD OF ALIGNMENT IS WITH A LASER ALIGNMENT DEVICE. GARDNER DENVER OFFERS FACTORY TRAINED TECHNICIANS AND LASER ALIGNMENT SERVICES. CONSULT GARDNER DENVER SERVICE GROUP FOR INFORMATION.

Methods of Shaft Alignment

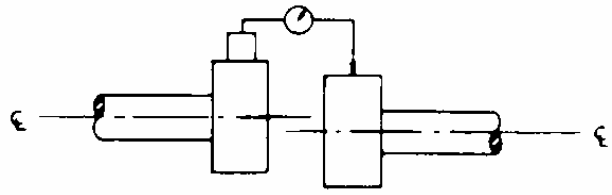
It is Gardner Denver's recommendation that the alignment methods used are with a laser device or with a dial indicator. The dial indicator method can be done by an experienced millwright or rotating equipment technician. The laser alignment procedure can also be accomplished by persons experienced using this equipment. Gardner Denver offers laser alignment field services. Consult factory for details.

Laser Alignment (Preferred)



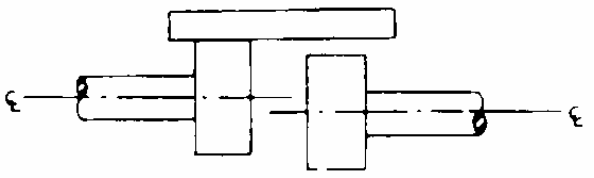
See instructions supplied with laser equipment

Dial Indicator



1. Clamp dial indicator on driving hub.
2. Locate indicator probe on O.D. of driven hub.
3. Rotate shafts simultaneously and take readings at 90° revolutions.
4. Misalignment of coupling is half of total run-out.

Straightedge (Not recommended)



Coupling Types

Blowers may be supplied with various coupling types best suited for the application, such as gear type, elastomer flexible element or disc type couplings. Whether mounted by Gardner Denver or by the end user, couplings must be installed and maintained in accordance with the manufacturer's instructions supplied with the equipment. **Final coupling alignment is the responsibility of the owner or installer.**

Gear type couplings installed by Gardner Denver are not lubricated prior to shipment. Any gear type coupling must have the gear teeth thoroughly hand-packed with the proper grease before placing the blower in service. If equipped with lube holes in the sleeve hubs, inject grease into the hubs until approximately half-full (grease begins to overflow through sleeve hubs). Follow manufacturer's instructions for lubrication type and frequency. The spacer type coupling is also acceptable and provides distinct benefits. It is, however, an extension of a standard coupling and is therefore not treated separately.

Motors

Ball Bearing Motors

A ball bearing motor can be direct coupled to the blower using an approved flexible coupling.

Sleeve Bearing Motors

When sleeve bearing motors are used, extreme care must be taken in establishing proper magnetic center alignment. Special selected couplings are available for this service and should be used to restrict the axial float of the motor rotor. The coupling manufacturer's installation instructions must be followed closely. Periodically inspect the blower's thrust bearing (inlet end) to prevent

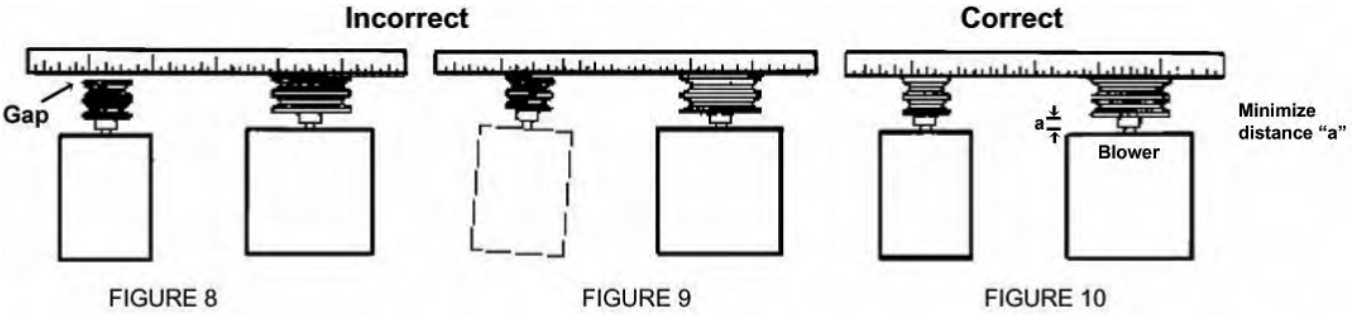


FIGURE 8

FIGURE 9

FIGURE 10

failure resulting from a shifting or hunting of the motor rotor about its magnetic center due to variable load conditions.

Belt Drive Alignment

Aligning a belt drive is much simpler than aligning a direct-coupled drive. To check alignment, place a straightedge across the face of the driving and driven sheaves. If properly aligned (see fig. 10), the straight-edge will contact both sheave faces squarely. Figures 8 and 9 show incorrect alignment. Keep sheave as close to blower as possible. Excessive distance between sheave and blower can reduce bearing life significantly.

Belt drive units should receive regular inspections to detect improper belt tension. (See following paragraph for instructions). This is particularly important a few days after initial installation. Belts that are too tight will result in excessive bearing stresses and loose belts will slip and fail prematurely. When replacing belts in a multiple set, ALL belts should be replaced. Tensioning of new belts should be increased by approximately 2 lbs. at calculated deflection to allow for stretching, and then rechecked after an eight-hour run-in.

Belt tension can be checked as follows: Divide the center distance “L” in inches by 64 to arrive at a deflection dimension “d”. The belts should have approximately 5-7 lbs. tension at this deflection. (See Figure 11) Belt tension measuring devices are available from most belt manufacturers and usually include instructions. Drive require-ments can vary by application. Contact factory for specific belt tension requirements or follow belt manufacturer’s instructions.

NOTICE

When belts are tensioned properly, a short duration squeal on start may be heard.

WARNING

Over-tightening belts leads to heavy bearing loads and premature failure.

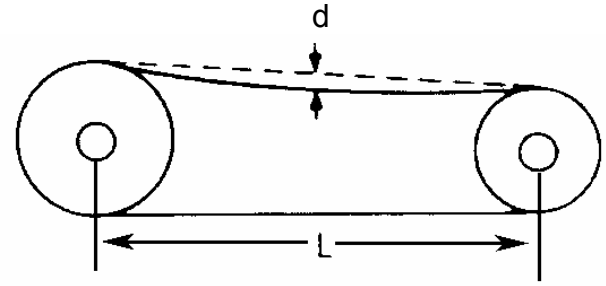
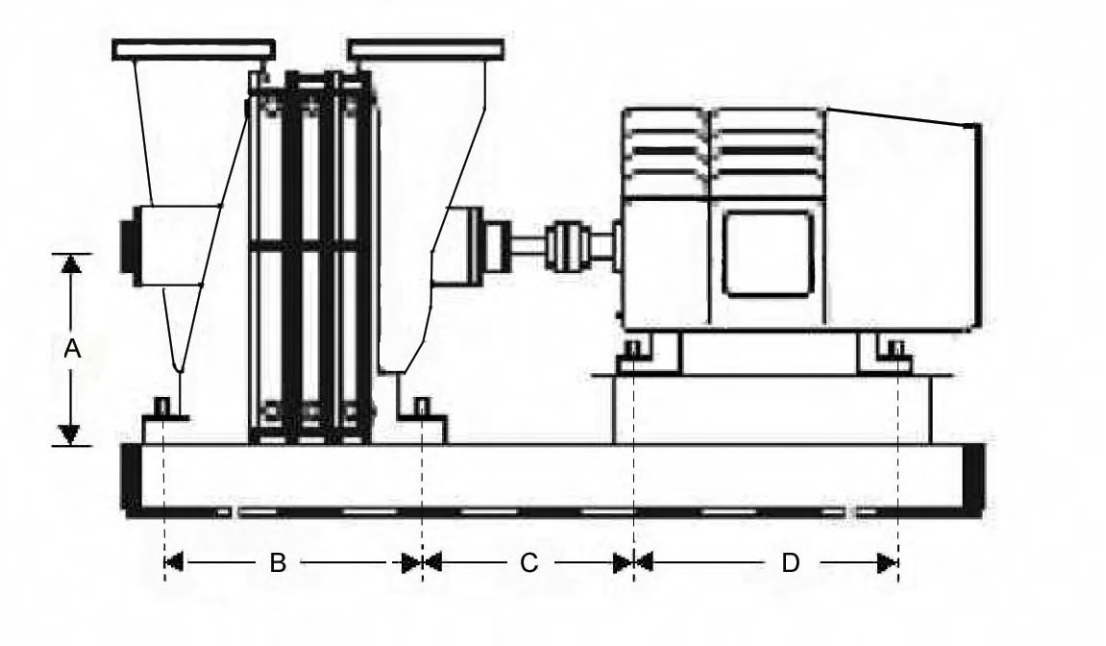


FIGURE 11

Checking Belt Tension

Hot Alignment Shimming Offset Guidelines



Calculations can be performed as follows:

Assumptions

- The only growth above ambient to take place is at discharge end of blower
- Inlet end is ambient and therefore considered stationary (no growth)
- Any thermal growth in motor is considered negligible and will not be used in these calculations

Necessary Terms for Calculating Thermal Offset

A = Height of shaft (the distance between the center line of the shaft and the bottom of the blower feet)

B = Distance between the blower feet (centerline of the hold-down bolts)

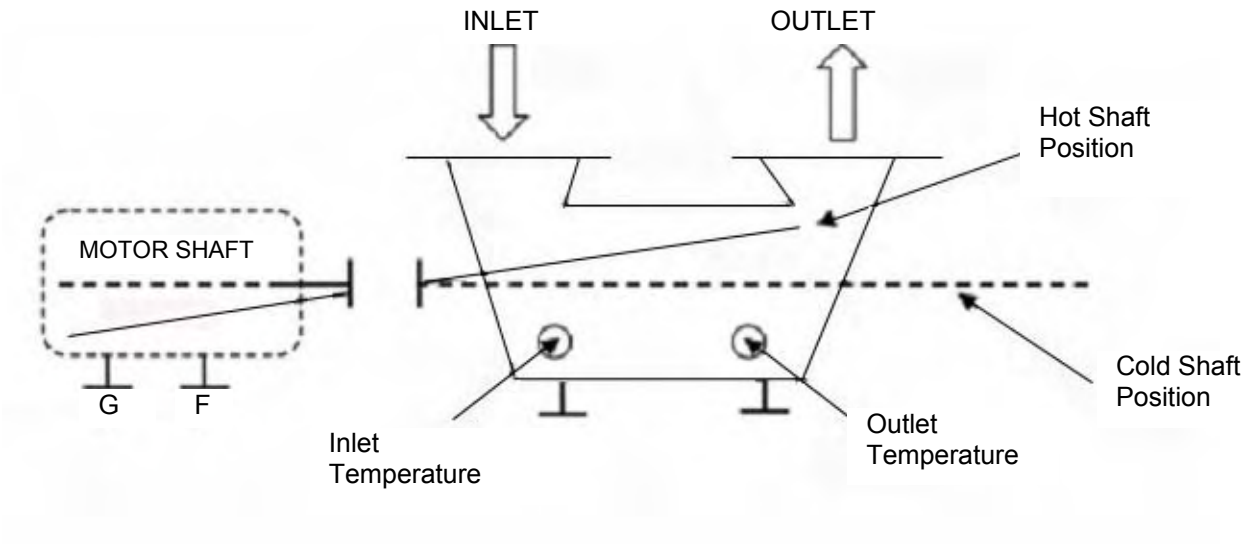
C = Distance from the drive end blower feet to the drive end motor feet

D = Distance between the motor feet

COE = Coefficient of expansion for cast iron is .000006" per inch/ °F

T ($\triangle$t) = The temperature change from inlet casing to outlet casing. (If the running temperature is not known, estimate 15 degrees per blower stage. For example, an 8-stage machine x 15 degrees would have a Δt of 120 degrees).

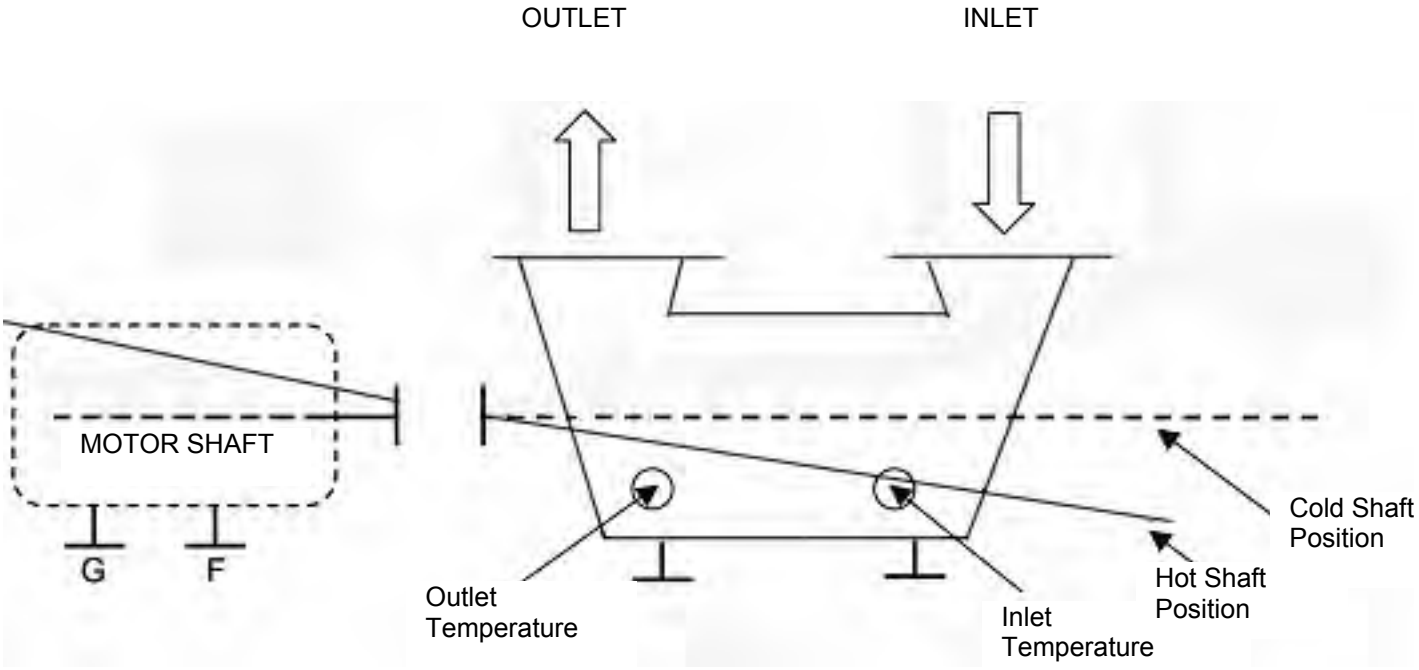
E = Thermal growth of the outlet in thousandths of an inch: Height of shaft (A) x Change in temperature (Δt) x .000006 (COE)



Thermal Offset Calculations for Inlet Drive Blowers
(Note: Motor is lower than blower. Offset will be negative number.)

On an inlet drive blower, it is necessary to set the motor shaft lower than the blower shaft when cold to compensate for thermal growth on the non-drive end of the unit. To find the offset for the motor feet:
From zero in the cold position, subtract:
Inlet drive motor front feet (F) = (C/B) x E
Inlet drive motor rear feet (G) = [(C+D)/B] x E

F and G are measured in thousandths of an inch. This is the amount to subtract from the feet of the motor once the alignment is zeroed under cold conditions.



Thermal Offset Calculations for Outlet Drive Blowers
(Note: Motor is higher than blower. Offset will be positive number.)

On an outlet drive blower, it is necessary to set the motor shaft higher than the blower shaft when cold to compensate for thermal growth on the drive end of the blower. To find the offset for the motor feet:
From zero in the cold position, add:
Outlet drive motor front feet (F) = [(C+B)/B] x E
Outlet drive motor rear feet (G) = [(B+C+D)/B] x E

F and G are measured in thousandths of an inch. This is the amount to add to the feet of the motor once the alignment is zeroed under cold conditions.

SECTION III
Operation

A. Pre Start-up Checks

□1 Visible damage (see Section I).
Check for any evidence of shipping and/or installation damages, such as cracked castings, scrapes, bent tie rods, etc.

□2. Verify proper installation (see Section II). Vibration pads installed; sufficient foundation; no grout; not bolted down; piping correctly installed and isolated from unit; inlet filters installed; all piping blind flanges removed. Be sure all motor and machine hold down bolts have been tightened securely.

□3. Coupling alignment (see Section II)
Alignment of the motor/machine must always be checked prior to initial start-up. **Alignment is the responsibility of the installer or owner.**

□4. Belt alignment (see Section II)
Always re-align sheaves and re-tension belts prior to initial start-up. Be sure belts are clean and dry. Re-check belt tension after the first couple of hours of operation.

□5. Lubrication (see Section IV)
Lubricate motor bearings per manufacturer's recommendations. Blower bearings on grease-lubricated machines have been sufficiently lubricated for approximately 1500 hours of normal operation. Verify that no water condensation has collected in the bearing housing by removing the housing cover and inspecting for moisture inside. If water is present, Gardner Denver recommends replacing the bearings to insure warranty coverage in the event of bearing failure. Consult factory. Do not attempt to repair machine during the warranty period.

Bearings of oil-lubricated machines require addition of recommended oil to the bearing reservoirs. New machines have sight glasses and are shipped with oil (Note: export units are shipped dry). Oil must be added to the proper level, which is to the middle of the bull's -eye.

□6. Safety guards
Couplings (or belt on belt drive) and motor fan guards should always be in place and tightened securely during operation. Do not operate machine with motor junction box open or any other electrical safeguard not in place. Make sure all starters or motor control centers are locked out when working on blower or motor.

□7. Electrical connections
Motor must be wired per data plate and the control panel connected per electrical drawing. All accessories such as valves, actuators, temperature sensors, etc. must be correctly wired per manufacturer's instruction. Unless otherwise noted in the manufacturer's instructions, Gardner Denver recommends the following field wiring:

120VAC - #14 AWG THHN

24VDC - #14 AWG THHN

Vibration Sensors (4-20 mA output) – 2 conductor shielded #18 AWG Belden 9318 or equal.

100 Ohm Platinum RTD Sensors – 3 conductor shielded #18 AWG Belden 9553 or equal

Current transformer (0-5A output) - #12 AWG THHN (There is a distance restriction between the current transformer and control panel. Please consult the control panel drawing for specific distance restrictions).

8. Initial start-up checklist

- ☐ Have you cleared with Operations personnel?
- ☐ No downstream maintenance being performed?
- ☐ Shaft spins freely by hand?
- ☐ All coupling guards and safety devices in place?
- ☐ Diffuser valves open, if applicable?
- ☐ Outlet butterfly valve to open?
- ☐ Inlet butterfly valve minimum stop or closed?
- ☐ All instrumentation properly wired and terminated to control panel, if applicable?
- ☐ Piping system ready for flow of air or gas?
- ☐ Atmospheric bypass valves open, if present?
- ☐ Energize control panel?
- ☐ Momentarily “bump” motor to verify proper rotation as indicated by arrow cast into inlet head.
- ☐ Verify proper lubrication of blower, driver and, where applicable, Gardner Denver supplied butterfly valves and couplings that require lubrication.

B. Operation

Press start button. Unit should reach full motor RPM in approximately 10 seconds. If not, de-energize control panel and investigate.

- When full motor RPM is reached and amperage draw decreases, slowly open inlet butterfly valve to achieve desired airflow (or amps). This should be done in less than 30 seconds.

- Allow machine to reach its operating temperature (see next page) and readjust flow rates as they may have decreased due to temperature variations.

- Adjust bypass valves (if present).

- Monitor vibration and temperature levels at the bearing housings and note any drastic or constant increases.

Although they may vary depending on size of unit and application, normal operating levels are:

Vibration: Less than 0.28 IPS (1.5 mils) in the vertical and horizontal plane at each end of blower.

It is important to note that Gardner Denver tests each machine prior to shipping.

Vibration acceptance criteria for testing are 0.24 IPS (1.25 mils) vertical, horizontal and axial planes on each bearing housing. Testing is done under ideal conditions. In actual job site operating conditions this value may not be attainable.

NOTICE

It is normal to hear "clacking" of the check valve during coast-down.

NOTICE

Motor starting amperage draw will momentarily indicate full scale on ammeter (if supplied).

1. Shutdown (normal and emergency)

- Press stop button.
- Open bypass valves (if present).
- In the event of an electrical malfunction during an emergency shutdown, de-energizing the control panel is recommended.
- **Do not restart blower after a shutdown or momentary power interruption until motor/blower shafts have stopped rotating completely. Rolling restart can cause severe damage.**

2. Operating temperatures

It is the nature of centrifugal compressors to run hot due to heat of compression and internal friction caused by movement of air. The higher temperatures will be on the discharge end of the machine. The following information will serve as a guide in determining acceptable temperature limitations under normal operating conditions. For specific applications or operating temperatures outside the figures shown, contact the factory.

3. Bearing temperatures

Bearings used in your Gardner Denver centrifugal blower are designed to operate continuously in temperatures in excess of 200 ºF (93 ºC). If bearing temperature monitors are not supplied, check bearing housing temperatures periodically

and notify Gardner Denver Service if readings exceed 220ºF (104ºC). Normal operating temperatures for bearings are under 200ºF (93ºC) when operated with inlet gas temperature of 100˚F and below.

4. **Discharge air temperature**

   Under normal operating conditions, using ambient or atmospheric air, typical discharge air temperatures can also exceed 200ºF (93ºC) measured in the discharge air stream or on the surface of the discharge (outlet) head. Use only discharge pipe and piping accessories rated for high temperature (300 ºF/149 ºC).

   Discharge temperature is affected by many factors including efficiency, flow, pressure, altitude, etc., so it is difficult to determine the exact discharge temperature the user can expect.

   Generally speaking, Gardner Denver discharge air temperatures should not exceed 250 ºF (121 ºC). If temperature is excessive, consult factory. Failure to do so could void the machine warranty.

CAUTION

If your Gardner Denver centrifugal blower is being used in a hot application such as steam recompression, or a similar application where inlet temperatures exceed 200 ºF (93 ºC), the machine must be preheated slowly to 180 ºF (82 ºC) minimum, prior to introduction of hot process air, gas or vapor. Sudden introduction of above without preheating can cause serious damage to the machine and will void the factory warranty.

C. Control Systems Tests

Surge Control Function Test (if surge control devices supplied).

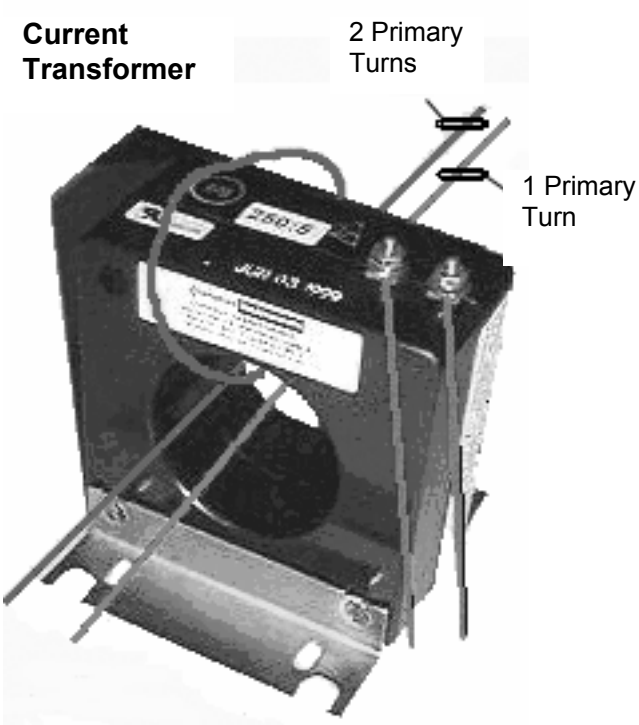
- Bring the machine up to operating speed.
- Set trip point slightly above surge point on meter. Different types of meters require different set-up procedures. Consult factory for specifications.
- With machine operating normally, slowly close throttle valve and observe amp reading. When amperage falls to surge set point, motor should drop out. If not, check to see that the current transformer has been installed with the number of turns identified on the control panel drawing.

NOTICE

A NOTE ON NOISE…Every effort has been made to keep the noise level of operating equipment below 85 dBA, the current acceptable limit mandated by OSHA. Although hearing protection is not required by law, the manufacturer suggests the use of hearing protection when operating this equipment.

NOTICE

Ship-loose current transformers that provide surge/overload protection are supplied with control systems. Please consult control panel drawings to determine the correct number of turns of the motor lead through the current transformer. Gardner Denver recommends installing current transformers in the motor control center. Consult factory if current transformer installation information is not readily available.



Installation Drawing for Current Transformer

Amperage Test

- Check meter for correct amperage reading.
- Compare actual amperage draw of the motor with that registered on the meter.
- With machine in full operation, use a "clamp-on" ammeter to measure actual amperage draw at motor or motor starter. This amount should be reasonably close to that registered on the meter (within 5%).

CAUTION

Surge is defined as the "unstable" flow of air through a machine. It can be caused by a lack of air into, or a restriction of air out of, a blower or exhauster. Surge is harmful to centrifugal machines because the heat of compression within the blower is not allowed to be carried off, resulting in the aluminum impellers expanding to touch the inside walls of the cast iron housing. The heavy pulsating action of a unit in surge will cause the bearings and machine to fail. In some cases where heavy surge is experienced, a centrifugal machine can fail within a matter of minutes. See page 28 for more on surge.

Overload Protection Test

- On units with motor overload protection, a high AMPS trip point is also on the meter. This adjustment varies with the type of meter used. Consult factory for details.
- With machine in full operation, adjust the meter, decreasing the set point until it is less than the meter reading. The overload alarm will sound and/or shutdown will occur.
- Be sure all horns, lights, etc. respond properly to the overload condition.

Bearing Temperature Monitors

- Most Gardner Denver thermal protection systems are calibrated and preset at the factory to alarm at 220 ºF and trip at 230 ºF (110 ºC). This high limit bearing temperature set point is sufficient for all Gardner Denver equipment and must not be adjusted.

Vibration Monitor System

- Vibration sensors must be installed securely to the blower with all wires shielded and secured according to manufacturer's recommendations.
- Verify the alarm and trip set points are set in accordance with manufacturer's recommendations. Gardner Denver recommends maximum settings of 0.4 IPS for alarm and 0.75 IPS for shut-down.
- Test of vibration protection system varies with each manufacturer. Therefore, consult manufacturer's installation manual for correct procedure of verifying proper operation.

Controls

- When Smartmeter, Multiguard or MDOCS systems are purchased, specific user manuals for these controls will be furnished.

SECTION IV
Bearing Lubrication

Proper maintenance and lubrication are extremely important to ensure long, reliable service from your Gardner Denver machine. Gardner Denver centrifugals are lubricated using grease or oil. The most common causes of overheating, noise and premature bearing failure are over-lubricating, use of the wrong type of lubricant or use of contaminated lubricant.

A. Oil Lubrication

Gardner Denver centrifugal blowers are supplied with sight glasses as standard or optional oilers. Gardner Denver blowers use Gardner Denver AEON CF-46 Lubricant. Use of any other oil without explicit approval of the Gardner Denver Service Department will automatically VOID THE MACHINE WARRANTY. Prior to starting, the oil reservoirs must be filled to the proper level.

AEON CF-46 is the standard lubricant and is recommended for most applications. AEON CF-150 may be used for those applications with a blower discharge air/gas temperature of 250 ºF or higher.

CAUTION

Gardner Denver Blowers/ Exhausters that are grease lubricated are shipped with the bearings pre-lubricated. Oil Lubricated Blowers/ Exhausters must have oil added to the bearing reservoirs prior to start-up. Do not overfill. Fill only to full mark on sight-glass.

GD AEON CENTRIFUGAL BLOWER LUBRICANTS

Hydraulic and circulation oils with corrosion, foaming, oxidation and rust inhibitors.

Name		GD AEON CF-46	GD AEON CF-150
Specific gravity, ASTM D 4052, 15ºC/15ºC		0.85	0.86
Pour point		-48 º C (-54 º F)	-45 ºC (-49 ºF)
Viscosity index, ASTM D 2270		135	144
Viscosity		48 cSt @ 40 ºC	143 cSt @ 40 ºC
		Part No.	Part No.
Available in:	Bottle, 1 quart	BC3018120000	300RGA786
	Case of 12 quarts	BC3018220000	303RGA786

AEON CF oil may be purchased from your Blower/Exhauster supplier or directly from Gardner Denver, Peachtree City, Georgia. (770) 632-5000

CAUTION

Add the oil slowly so it can drain off the internal parts. DO NOT OVERFILL.

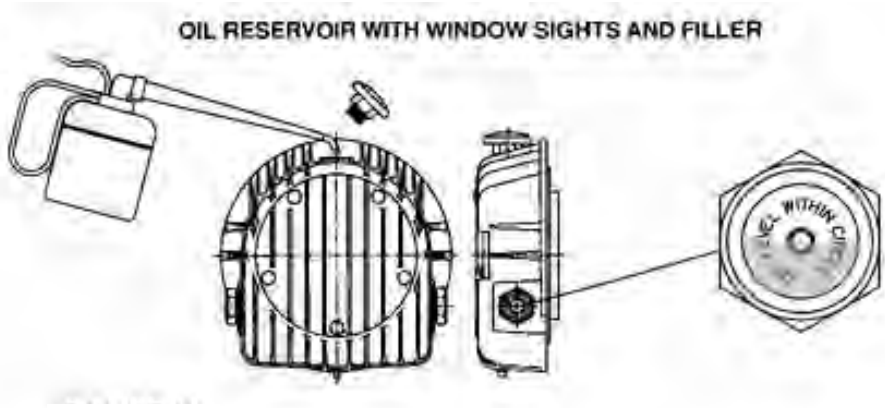


FIGURE 12

Oil Lubrication Frequency

Standard Conditions
6 months/ 4000 Hrs.

Severe Conditions
3 months/ 2000 Hrs.

Extreme Conditions
1 month/ 1000 Hrs.

1. To check the sight glass oil level:
   a. Stop the unit and allow it to come to a complete stop.
   b. Sight glasses are located on both sides of the reservoir. The oil level is at the proper level when it is within the center of the glass.
   c. To add oil to the reservoir housing, remove the filler/breather filter located on top of the reservoir. Add oil through this hole until the oil has reached the proper level as indicated by the sight glass (See Figure 12).

B. Grease Lubrication

Over-greasing can be more dangerous than under-greasing. For this reason, Gardner Denver does not recommend use of permanently installed grease fittings, which invite over-greasing.

A special high speed grease, Gardner Denver AEON Centrifugal Blower Lubricating Grease, is required in Gardner Denver grease-lubricated machines. Use of any other type of grease without explicit approval of Gardner Denver Service Department will automatically **void the machine warranty.** Gardner Denver AEON Centrifugal Blower Lubricating Grease may be purchased from the supplier of the blower/exhauster or directly from Gardner Denver Customer Service at (770) 632-5000.

AEON Lubricating Grease is formulated using a polyalphaolefin synthetic base fluid with a high quality lithium complex thickener to provide outstanding protection against wear, rust corrosion and high temperature degradation.

Since different types of grease may not be compatible, it is important not to mix various products. Use of different types of grease may lead to early bearing failure.

Prior to shipment, blower/exhauster bearings are adequately lubricated. If three months or more have elapsed since shipment from the Gardner Denver factory, remove bearing housing covers and inspect for moisture due to condensation.

Greasing Procedure:

1. With the machine fully stopped, remove bearing cover and plugs.
2. Remove all old grease from face of bearings, housing and cover using a clean rag. It is not necessary to remove bearings.
3. Remove plug on back side of bearing housing. Apply grease into this port forcing old grease from bearing. Wipe excess from bearing and install small amount into cap.
4. Reinstall plugs and bearing cover and start unit.

Gardner Denver AEON Centrifugal Lubricating Grease

NLGI grade ..... No. 2

Thickener type ..... Lithium Complex

Penetration, Worked, 25°C, ASTM D217 280

Dropping point, ASTM D2265..... 275 ºC

4-Ball Weld, ASTM D 2596, Load, kg 250

Viscosity of oil, ASTM D445 ..... 100 cSt @ 40°C

Temperature range..... –58 ºF to 350 ºF (-50 ºC to 177 ºC)

		Part No.
Available in:	**Case of 12 – 5 ounce tubes**	**304RGA786**
	Case of 12 – 14 ounce cartridges	**305RGA786**

Series	Full Replacement	Periodic Addition
310, 400	1.6 oz. (45 g)	1 oz. (28 g)
510, 550, 42	3.1 oz. (87 g)	2 oz. (56 g)
850, 732, 741, 742	5.5 oz. (154 g)	3 oz. (84 g)
870,1260,1270	7.0 oz. (196 g)	4 oz. (112 g)

Operating Conditions and Grease Lubrication Intervals

	Operating Conditions	Lubrication Frequency
Standard	Up to 24 hours per day in a clean environment. Normal or light loading.	Every 6 months or 3000 hrs.
Severe	24 hours per day in a dirty or dusty environment.	Every 3 months or 1500 hrs.
Extreme	Same conditions as "Severe" but with heavy dust or vibration.	Every month or 750 hrs.

SECTION V
Maintenance

Gardner Denver offers a full range of factory technician maintenance programs at very competitive prices. Consult Gardner Denver Service for details and warranty extension programs.

Simple maintenance procedures will help prolong the life of your Gardner Denver blower:

A. Periodically inspect foundation and correct if deficiencies are found. Check for level condition and correct as necessary.
B. Check condition of isolation pads and replace as necessary (recommended every 3 years).
C. Periodically check all valves in the system. A stuck or broken valve can cause severe damage to equipment.
D. Alignment should be checked and corrected yearly (twice yearly in northern climates).
E. Check pipe supports and adjust if necessary.
F. Keep equipment clean. If machine is oil-lubricated, be sure to keep oiler bottle or sight glass clean so oil, or lack of, can be seen. Keep oil breather clean to prevent leaks.
G. Review motor Operating & Maintenance manual for all pre start-up requirements, including lubrication. Follow motor manufacturer's recommendations for motor maintenance.
H. Vibration readings and bearing temperature readings should be taken periodically to monitor the condition of the machine bearings, which are the most critical component in the machine. If necessary equipment is not available, consult Factory Service Department.

SECTION VI
Service

There are some service functions that can be performed easily on your Gardner Denver centrifugal blower. These include bearing changes, seal changes, coupling service and some other external type repairs.

Failure to notify Gardner Denver prior to working on your centrifugal blower for any reason within the warranty period will void the factory warranty.

NOTICE

Gardner Denver has Bearing Kits and Seal Kits available in stock for immediate shipment. These kits contain all the items and instructions required for complete bearing and seal changes on both ends of the machine. To place an order, please call Customer Service at (770) 632-5000.

WARNING

Major repairs usually require dismantling of the machine. This should only be performed by a Factory Service Technician. In all cases, you should contact Gardner Denver Service in Peachtree City, Georgia (770) 632-5000.

SECTION VII
Troubleshooting Guide

PROBLEM: Low Air Flow or Loss of Pressure

1. Incorrect machine rotation
   - Check arrow on inlet

2. Restricted inlet piping
   - Valve not fully open
   - Dirty filters
   - Shipping covers not removed

3. Partially blocked outlet piping
   - Open all outlet valves
   - Check valve installed properly
   - Clogged diffusers

4. Instrumentation not reading accurately

5. Verify motor wiring
   - Incorrect voltage
   - Incorrect phasing

6. Increased inlet temperature

7. Increased inlet pressure

8. Improper design or assembly of the piping system

9. Foreign material in machine

PROBLEM: Excessive Vibration

1. Baseplate must never be bolted down or grouted in

2. Isolation pads
   - Positioned incorrectly
   - Improperly sized
   - Poor condition

3. Expansion joints
   - Machine must be isolated from system piping by flexible sleeves or expansion joints. **NEVER** bolt piping directly to blower.

4. Misalignment
   - The number one cause of excessive vibration in Gardner Denver equipment.

5. Foundation
   - The blower shall rest on a solid, level, flat surface such that it will support the weight of the unit.

6. Unsupported piping
   - The piping system must be adequately supported above the flexible connections.

7. Loose hold-down bolts
   - The motor and machine hold-down bolts may have loosened.

8. Foreign material in machine
   - Liquids (such as water, etc.)
   - Hardware (such as bolts, filter pieces, etc.)

9. Surge
   - Operating in the surge range
   - Blocked inlet or outlet piping

10. Motor vibration
    - Improper voltage
    - Failing motor bearings
    - Imbalance within motor (such as broken fan, etc.)

11. Blower/Exhauster bearings
    - Damaged during replacement
    - Over-lubrication or wrong type of lubricant
    - Wrong type of bearings
    - Inadequate storage maintenance

12. Coupling
    - Improper lubrication
    - Incorrect shaft spacing
    - Imbalance (such as damaged coupling or wrong size key)
    - Loosened set screws

13. Imbalance
    - Motor (due to rotor, bearings or fan)
    - Coupling
    - Rotor (due to impellers, shaft or bearings)

PROBLEM: Oil Leakage

1. Oil level too high
   - Operator or maintenance personnel overfilling reservoir
   - Improper oil level adjustment

2. Wrong type of oil (use recommended oils ONLY)

3. Breather vent clogged or vent hose clogged or pinched

4. Labyrinth or carbon ring seal leaking excessively

5. Incorrect bearing assembly
   - Oil slinger bent or not positioned properly
   - Housing gasket loosened or damaged
   - Gasket blocking oil return hole
   - Brass labyrinth seal oil drain holes not at bottom
   - Labyrinth loose in bearing housing

6. Oil reservoir glass cracked

7. Loose connections to oiler

8. Oilers located on wrong side of machine

9. Oil return holes plugged

10. Machine not level

PROBLEM: Overheating

1. Overheating Machine
   - Surge
   - Inadequate air flow
   - Clogged intake air filters
   - Incorrect use of discharge valve to control flow

2. Overheating Bearings
   - Damaged bearings
   - Excessive lubrication or wrong type
   - Incorrect class of bearings
   - Improper assembly procedure
   - High ambient temperatures
   - Worn housing
   - Worn retainer

3. Overheating Motor
   - High ambient temperatures
   - Incorrect voltage
   - Unbalanced voltage supply
   - Restricted air flow (for cooling)
   - Motor overloaded – motor too small for system
   - Improperly tensioned belts on v-belt drive systems
   - Bearing failure
   - Too frequent starting
   - Motor fan rotation incorrect

PROBLEM: Repeated Bearing Failures

1. Not using Gardner Denver bearings

2. Not using Gardner Denver recommended lubricant

3. Excessive lubrication or lack of lubrication

4. Improper assembly
   - Correct number of bearing shims
   - Wavy washer positioned properly
   - Oil and grease slingers positioned properly
   - All gaskets to original thickness specs

5. Bearing housings worn excessively, shaft journal worn

6. Coupling alignment
   - Coupling manufacturer specs followed for:
     a) hub-to-hub spacing
     b) shaft-to-shaft axial clearance
     c) lubrication (if required)

7. Shafts not rotated weekly on idle units

8. NOTE: Many non-mechanical problems can lead to frequent or repeated bearing failure. They may include improper installation, application or operation of machine.

PROBLEM: Surge

1. Restricted inlet piping

2. Blocked outlet piping

3. Increased fluid level in aeration tank or process differential pressure

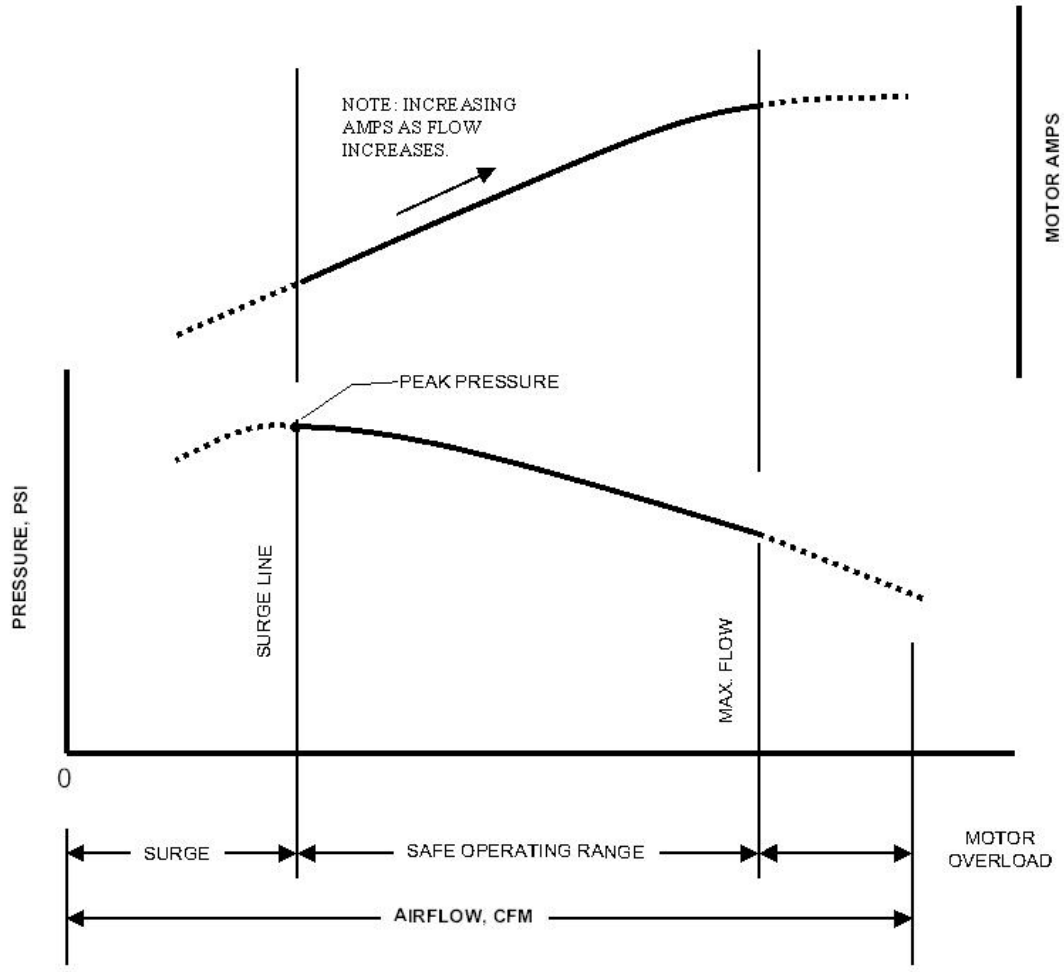
4. System imbalance

5. Incorrect valving or valve timing.

SECTION VIII
Surge in Centrifugal Blowers

Surge is a phenomenon that happens when airflow through a centrifugal blower is reduced to a point beyond the maximum peak pressure of the blower.

As flow is reduced, pressure rises until the maximum pressure point is reached. As flow is further reduced, pressure then drops below this peak point, and the downstream pressure blows back into the blower. This creates a pulsation inside the machine, a very unstable condition.



As the illustration shows, when flow is reduced to the area left of the surge line, pressure and flow drop, creating an unstable condition.

The following things happen to blowers in surge:

1. Pulsation of air in and out of blower causes undue stress on rotor and bearings
   - Thrust loading on bearings is greatly increased
   - Instability, when severe enough, can cause rotor displacement (movement)

   - Bearing failure can also cause rotor to become eccentric, causing failure axially and radially

Damage caused by surge is usually indicated by one or more of the following:

- Severe damage to impellers
- Collision of the aluminum and cast iron surfaces is catastrophic
- Bearing failure
- Possible shaft damage (discoloration, scoring, deflection)
- Discoloration of blower components due to high temperatures
- Aluminum in the inlet head of blower

2. Loss of flow through the machine and higher pressure increases heat inside the machine
   - As pressure approaches peak, heat increases due to heat of compression
   - Lower flow (or no flow) inhibits machine's ability to carry internal heat out of machines
   - Increase in heat can compromise close radial clearances of impeller diameters
   - Impellers can actually hit casing, causing severe damage

Some things that can cause surge are:

- Dirty or plugged intake filters
- Faulty or inoperable valves
- Incorrect valve settings
- Piping restrictions; pipes too small
- Improperly sized blow-off
- Downstream pressure or resistance in excess of blower's maximum pressure capability
- Reduction in speed, causing lower flows
- Upstream restrictions in piping or process

APPENDIX A

WARRANTY, REPAIR & TECHNICAL FIELD SERVICES

POLICY:
The services of a technician or engineer from Gardner Denver Engineered Products Division to inspect or repair a machine in the field, whether under warranty or not, are subject to a service charge. A firm commitment in the form of a hard copy purchase order will be required before the technician or engineer leaves from any of our US offices. For Domestic and International technical field services, contact Gardner Denver (770-632-5000) for current rates and expense charges.

A Purchase order or a signed letter of intent must be faxed to the Service Department at 770-631-0765 before any service can be performed.

If the machine in question is under warranty and inspection by the Gardner Denver technician or engineer reveals a defect or deficiency for which the factory is accountable, the service charge will be rescinded. However, if in the judgment of the technician or engineer the factory is not accountable for whatever defect or deficiency exists, then the service charge will apply. Gardner Denver terms and conditions will apply to all field service work.

PARTS:
Any parts used for service will be billed at the prevailing prices unless repair is being covered under warranty. *All parts are shipped Ex Works factory*.

MATERIAL RETURN POLICY

Request to return merchandise must be in writing, listing full identification and quantities for each item. Reference must be made to the invoice number, as well as the purchase order number, against which the merchandise in question was purchased. Only standard materials or equipment will be considered for return. Sales of customized or modified equipment are final and not subject to return. Material approved for return must be in a new or unused condition. Quantities as verified by the Gardner Denver Engineered Products Division Receiving Department will be accepted as final. Terms of shipment must be prepaid, FOB destination. Any damage incurred in transit will be charged to the account of the shipper.

There will be a minimum 25% handling and restocking charge for materials returned and accepted in first class condition. (Minimum charge of $100.00). No credit memorandum will be issued where the net amount involved is less than $100.00 except where an error made by Gardner Denver Engineered Products Division is being corrected.

In the event that material returned does not satisfy the criteria established for acceptance, the customer will be given the option of accepting a reduced allowance for the material or having it returned to them at their expense.

PROCEDURE
Materials shipped in to Gardner Denver must bear an authorized return number supplied by the Gardner Denver Engineered Products Division and must be clearly marked with all pertinent information. Any shipment made to Gardner Denver Engineered Products Division without due authorization will incur a further charge of $100.00 for handling and processing.

APPENDIX B

TERMS AND CONDITIONS

EXCEPT AS OTHERWISE AGREED IN WRITING, THESE TERMS AND CONDITIONS GOVERN ALL OUR CONTRACTS TO THE EXCLUSION OF OTHER TERMS AND CONDITIONS. OUR QUOTATIONS AND ESTIMATES ARE NOT OFFERS CAPABLE OF ACCEPTANCE BY YOU, AND ANY ORDER PLACED BY YOU WILL ONLY BE ACCEPTED BY OUR WRITTEN CONFIRMATION OF SUCH ORDER.

GENERAL PROVISIONS

1. The definition of terms used, interpretation of this agreement and rights of parties hereto shall be construed under and governed by the Uniform Commercial Code of the State of Illinois. "Seller" when used herein means GARDNER DENVER, INC. "Purchaser" when used herein means the person, firm or corporation to whom this quotation is addressed. And "Equipment" or "Products" means those articles, supplies, and drawings, data or other property or services described herein.
2. All quotations are for immediate acceptance and subject to change or withdrawal without notice before an order is acknowledged by Seller. This proposal shall not become effective until accepted by an authorized employee of the Seller. This proposal cannot be changed or varied by any verbal agreement. If this proposal is deemed to constitute an offer, it may be accepted only on terms set forth in this proposal, including, without limitation, these Terms and Conditions. If this proposal constitutes an acceptance of an offer, such acceptance is expressly conditioned on Purchaser's assent solely to the terms of proposal, including, without limitation, these Terms and Conditions. An acceptance of any part of the Equipment or services covered hereunder shall be deemed to constitute such assent. Any additional and/or different terms and conditions proposed by Purchaser and/or any attempt by Purchaser to vary any of these terms and conditions shall be deemed a material alteration and is hereby objected to and rejected.
3. Unless otherwise agreed by Seller in writing, Seller's prices are subject to change without advance notice at any time prior to order acknowledgment. Seller reserves the right to adjust the invoice price, after the price is quoted and/or acknowledged, to take account of any material variation in Seller's costs beyond Seller's reasonable control since the date of the quotation or (if no quotation is issued) the order acknowledgement, and the invoice so adjusted shall be payable as if the price set out therein were the original contract price. All sales are subject to increase without notification by the amount of any sales or excise tax levied or charged by any governmental agency and are subject to any price adjustment necessitated by Seller's compliance with any government action.
4. All sales under all orders and these terms and conditions are subject to Seller and/or Government priorities, laws and regulations, now or hereafter established.
5. The Seller reserves the right to change, discontinue or modify the design and construction of any product or to substitute material equal to or superior to that originally specified, without notice to the Purchaser.
6. All claims by Purchaser for shortages in a shipment of Equipment or Equipment damaged in transit must be made against the carrier. All claims by Purchaser against Seller for nonconforming Equipment and claims for shortages in a shipment or damaged Equipment (other than claims to be made against the carrier) must be made in writing to Seller within ten (10) days after receipt of shipment or thirty (30) days after date of shipment, whichever occurs first, or they are waived.
7. Any action for breach of the contract hereunder must be commenced within one year after the cause of action has accrued. Only variations or modifications to the contract, which are made in writing signed by Seller and Purchaser, shall be enforceable. Any failure by Seller to enforce its rights under this contract will not be deemed a waiver of such rights.
8. All disputes arising under or in connection with this Contract shall be resolved by (a) good-faith negotiations by knowledgeable, responsible representatives of each party who are fully authorized to settle any such dispute, or (b) in the event such negotiations do not resolve such dispute, binding arbitration held in Chicago, Illinois, by a single arbitrator pursuant to the Commercial Arbitration Rules of the American Arbitration Association. Each party shall bear its own costs of these procedures; the parties shall equally split the fees of the arbitration and the arbitrator. Notwithstanding the above, either party shall have the right to seek a temporary restraining order or an injunction related to the purposes of this Contract, to compel compliance with confidentiality obligations, or to file suit to compel compliance with this dispute resolution process.
9. Purchaser may not assign, novate or otherwise transfer its rights or obligations under this contract without Seller's prior written consent, and any attempt to do so shall be null and void and of no effect.
10. The minimum order value is $100.00.

CANCELLATION

Purchaser cannot cancel orders under any circumstances without Purchaser first reaching an agreement in writing with Seller covering all Sellers' damages. For standard Equipment (catalogue equipment, ordinarily carried in stock), such agreement shall provide, at a minimum, a cancellation charge of at least 15% of the purchase price of the goods covered by the cancelled orders to cover overhead and profit. In addition, for special Equipment (i.e., equipment manufactured per Purchaser's requirements, and not stocked as a standard product), cancellation charges must, at a minimum, reimburse Seller for all expenses incurred (including but not limited to costs of purchased materials), engineering costs, and an amount to cover overhead and profit, and will based on the following schedule of minimum values, whichever is greater: Order Entry --- 10% of purchase order value; Completion of Engineering --- 25% of purchase order value; Materials on Order --- 50% of purchase order value; Fabrication Started --- 100% of purchase order value.

ENGINEERING CRITERIA

The Equipment furnished by Seller are sophisticated engineering products; accordingly, Purchaser undertakes:

1. That it has provided and will promptly provide all the information reasonably necessary to enable Seller to (i) evaluate the requirements for performing and (ii) perform the Contract, and that all such information is full and accurate;
2. That all premises, plant, engineering support, spare parts, connected pipe work and machinery and inputs that it is required to provide for the design, engineering, installation, testing and use of the Products are fit for their purpose and of good engineering quality;
3. Fully to co-operate with Seller in the design, engineering, installation, testing and use of the Products;
4. To use the Products for the intended purpose only and in accordance with the Product literature; and
5. Not under any circumstances, to use any unapproved spare part, connected machinery, service or repair or use the Products in any manner as may render the Products dangerous and agrees that any breach of these negative criteria will negate all specific and implied conditions and obligations on the part of Seller relating to the quality of the Products.

Purchaser further agrees that it will be liable to Seller for any costs, expenses and losses it suffers by reason of any breach of these undertakings.

DRAWINGS, DESIGNS AND CONFIDENTIALITY

1. All of Seller's specifications, designs, drawings, indications of physical, chemical and electronic properties and indications of inlet pressure or vacuum, pressure output and power consumptions ("the Designs") are made in good faith and are approximate indications only and are not binding in detail unless Purchaser has specified in writing a particular indication upon which he is relying and Seller shall be entitled to vary the same and/or to correct errors and omissions provided the Products remain in substantial conformity with the contractual requirements.
2. The Designs (including all copyright, design right and other intellectual property in them) shall as between the parties be the property of Seller; and Purchaser is not entitled to make any use of the Designs other than for the purpose of this Contract.
3. Any inventions, modifications, improvements, techniques or know-how affecting the Products made or gained in the course of performing this Contract shall belong to Seller absolutely.
4. Neither party shall disclose to third parties or use for its own purposes any confidential information or trade secrets of the other party.

SHIPMENT, PAYMENT AND CREDIT

1. Credit Terms of Payment: A. Domestic – Net thirty (30) days from date of invoice. Delinquent accounts shall bear interest at 18% per annum thereafter, until paid. Said interest rate shall be reduced to the maximum permissible rate in any state having laws, which so require. B. International – Unless otherwise agreed to by the Seller's Manager of Credit and Collection, payment shall be in U.S. Funds by wire transfer or irrevocable Letter of Credit, confirmed by a major U.S. Bank. In addition to such late payment charges, Seller may add to the amount past due any costs associated with collection thereof, including reasonable attorneys' fees.
2. Seller may, in its sole discretion, accept payment for Products by cash in advance or by money-down with scheduled progress payments, and unless Seller agrees otherwise in writing, in it's sole discretion, orders over $100,000 will be subject to progress payments.
3. Shipments and deliveries shall be subject to approval of Seller's Credit Department. If Purchaser fails to fulfill the terms of payment, or if at any time before payment in full is made (whether or not payment is yet due) a petition is presented or resolution passed for the winding up or bankruptcy of Purchaser, or in the event of the appointment of a receiver or administrator of Purchaser's business, Seller may defer further shipment or at its option, cancel the unshipped balance. Seller reserves the right previous to making any shipments, to require from Purchaser satisfactory security for performance of Purchaser's obligation. No failure of Seller to exercise any right accruing from any default of Purchase shall impair administrator of Purchaser's business, Seller may defer further shipment or at its option, cancel the unshipped balance. Seller reserves the right previous to making any shipments, to require from

Purchaser satisfactory security for performance of Purchaser's obligation. No failure of Seller to exercise any right accruing from any default of Purchase shall impair Seller's right in case of any shipment default of Purchaser.

4. All sales are ex-works unless otherwise expressly stipulated. Seller may, in its discretion, select the carrier unless specified in advance by Purchaser.
5. Seller's responsibility for damages in transit ceases upon delivery of goods to destination specified in the Order and Purchaser then assumes responsibility for damage determination and collection from carrier.
6. While expected dates of delivery of goods are given in good faith, the same are not of the essence of or in any way terms of the contract or representations of fact. All shipping dates given are approximate, and while effort is made to maintain schedules, Seller will not be liable for damages on account of delay. In case of delay by Purchaser in furnishing complete schedules or information, delivery dates may be extended for a reasonable time depending on factory conditions. The Seller shall not be responsible for reasonable or excusable delays nor shall the Purchaser refuse to accept delivery because of any such delays. Excusable delays include, without limitation, delays resulting from accidents, fires, floods, severe weather or other acts of God, strike, lockout or other labor difficulties, embargoes, government controls or other forms of intervention, inability to obtain labor, materials or services and other causes beyond Seller's control. If there is a scarcity in any of its products or goods, Seller will allocate its available supply in its sole discretion.
7. All Equipment or parts furnished by Seller shall remain the property of Seller until paid for in full. Pending payment of the full purchase price of the Equipment or parts furnished by Seller, Purchaser shall at all times keep the Equipment or parts comprehensively insured against loss or damage by accident, fire, theft and other risks usually covered by insurance in the type of business carried on by Purchaser in an amount at least equal to the balance of the price for the same from time to time remaining outstanding.
8. Between delivery and payment in full, the risk in the Equipment furnished by Seller shall be with Purchaser, who shall keep the same in good condition and repair, properly stored and labeled as being Seller's property.
9. In the event of Cancellation in accordance with the provisions hereof, or in the event of non-payment (in full or in part) for the Equipment by the due date, Purchaser hereby irrevocably licenses Seller (insofar as it is able) to enter upon any premises to repossess the Equipment.

INDEMNITY

Purchaser will indemnify, defend and hold Seller, its affiliated companies and their respective directors, officers, employees and agents harmless from any loss, claim, cost, expense or damage (including payment of reasonable attorneys' fees) suffered or incurred by any of them and/or for which any of them may be liable to any third party due to, arising from or in connection with, directly or indirectly:

(i.) any violation of law, negligence, omission or intentional misconduct on the part of the Purchaser, its servants, agents or employees;
(ii.) Purchaser's instructions or lack of instructions or Purchaser's failure or delay in taking delivery;
(iii.) the breach of any provision of this Agreement by Purchaser; or
(iv.) any infringement or alleged infringement of patents, trademarks, copyright, design, right or other intellectual property right occasioned by the importation, manufacture or sale of the Equipment if made to the specification or special requirement of Purchaser.

LIABILITY

Seller's total liability for any and all claims, damages, losses and injuries arising out of or relating to Seller's performance or breach of any term herein shall not exceed the purchase price of the Equipment. IN NO EVENT, WHETHER IN CONTRACT, TORT OR OTHERWISE, SHALL SELLER BE LIABLE FOR LIQUIDATED, INDIRECT, EXEMPLARY, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, EXPENSES OR COSTS, INCLUDING BUT NOT LIMITED TO: (1) LOSS OF PROFITS, BUSINESS OR GOODWILL; (2) LOSS OF USE OF EQUIPMENT OR FACILITIES; OR (3) LOSS RESULTING FROM UNUSABLE MACHINERY OR FACILITY DOWNTIME, HOWSOEVER CAUSED AND EVEN IF THE POTENTIAL FOR SUCH DAMAGES WAS DISCLOSED AND/OR KNOWN.

DISCLAIMER OF WARRANTY

SELLER DOES NOT WARRANT THE MERCHANTABILITY OF ITS PRODUCTS AND DOES NOT WARRANT THE FITNESS OF THE PRODUCTS FOR A PARTICULAR PURPOSE. SELLER DOES NOT MAKE, AND HEREBY DISCLAIMS AND EXLUDES, ANY WARRANTY, EXPRESS OR IMPLIED, OTHER THAN THE WARRANTY CONTAINED HEREIN. THERE ARE NO WARRANTIES EXPRESS OR IMPLIED BEYOND THAT WHICH IS DESCRIBED BELOW.

WARRANTY OF GOODS MANUFACTURED BY SELLER

1. Except to the extent Seller specifies another warranty period in writing, Seller warrants products and parts manufactured by it and sold hereunder to be free from material defect in material and workmanship for a period of twelve (12) months from date of startup or eighteen (18) months from date of shipment whichever occurs sooner (the "Warranty Period") provided, however, that Seller's sole responsibility under this warranty shall be to either repair or replace at Seller's option, any part which fails during the Warranty Period because of a defect in workmanship and material. Such replacement parts shall be provided at no cost to Purchaser, at the business establishment of Seller, or a repair facility authorized by Seller, during regular working hours. No Equipment may be returned by Purchaser without Seller's prior written consent, and Seller will not be liable for costs incurred by Purchaser in connection with returning equipment or parts, or otherwise, without Seller's prior written consent. Seller's obligation under this warranty shall not include any transportation charges, cost of installation, duty, taxes or any other charges whatsoever.
2. Seller shall be under no liability for breach of the warranty set forth herein: (i) unless the Equipment has been properly installed, used, maintained and serviced; (ii) unless Purchaser has promptly informed Seller in writing of the defect alleged within the Warranty Period and within 7 days of the discovery thereof; (iii) with respect to wearing and consumable parts; (iv) if Purchaser places Products in long-term storage and fails to perform proper long-term storage preparations per Seller's instructions; and/or (v) to Equipment or component parts or accessories thereof not manufactured by Seller.
3. Seller makes no representation regarding compliance with any state, provincial, or local law, rules, regulations, building code or ordinance relating to the installation or operation of the Equipment.
4. If the Purchaser informs the Seller of a defect after the Warranty Period has expired, then Seller may offer advice (free of charge) and may offer repair or replacement at Purchaser's expense. Any dispute as to whether a defect is covered by the Warranty shall be immediately referred to an expert to be agreed by Seller and Purchaser whose decision shall be final and binding upon the parties.
5. There are no third party beneficiaries of the Warranty granted by Seller herein.

WARRANTY OF OTHER MANUFACTURER'S PRODUCTS

Seller makes no warranties or representations of any kind whatsoever, either expressed, implied or statutory on any component parts or accessories sold hereunder which are not manufactured by Seller. Seller hereby extends the manufacturer's warranty or guaranties, if any, given to Seller by the manufacturer of said component parts and accessories, but only to the extent Seller is able to enforce such warranty or guaranties. Seller does not guaranty warranties of other manufacturers' products. Claims under any manufacturer's warranty shall be made in accordance with the manufacturer's requirements regarding the return, repair or replacement of the goods. Seller agrees to use its best efforts and will cooperate with Purchaser in enforcing any claims against manufacturer(s) for defects that may occur. Seller has not authorized any party to make any representation or warranty other than the above warranty statements.

CONFLICTING LAW

Some jurisdictions provide rights in addition to those listed above, or do not allow the exclusion or limitation of implied warranties, or liability for incidental or consequential damages. If any provision or part of a provision of these terms is found to be illegal, invalid or unenforceable under any applicable law, such provision or part of a provision shall, insofar as it is severable (whether or not payment is yet due) a petition is presented or resolution passed for the winding up or bankruptcy of Purchaser, or in the event of the appointment of a receiver or administrator of Purchaser's business, Seller may defer further shipment or at its option, cancel the unshipped balance. Seller reserves the right previous to making any shipments, to require from Purchaser satisfactory security for performance of Purchaser's obligation. No failure of Seller to exercise any right accruing from any default of Purchase shall impair Seller's right in case of any shipment default of Purchaser. from the remaining terms, be deemed omitted from these terms and shall in no way affect the legality, validity or enforceability of the remaining terms.

SPECIAL PROVISIONS

The Equipment or parts sold hereunder are not designed or manufactured for use in or with any atomic installation or activity. If Purchaser or the ultimate user of these products intends to use them in such an installation or activity, Seller's Terms for Nuclear Sales shall be a part of this Contract. Seller will furnish Purchaser with a copy of its Terms for Nuclear Sales upon request .

For additional information, contact your local representative or

Gardner Denver Engineered Products Division

100 Gardner Park, Peachtree City, GA 30269
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